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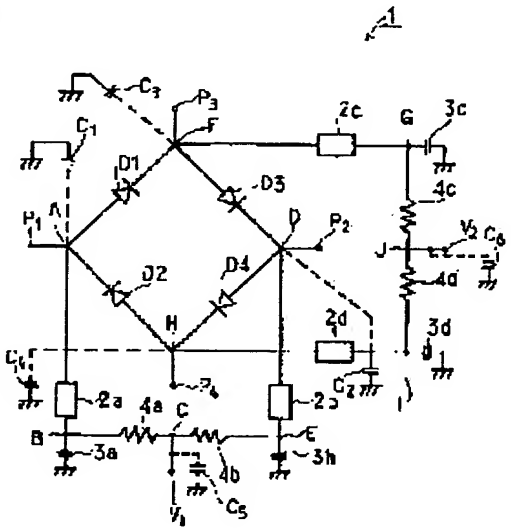
(54) HIGH FREQUENCY SWITCH

(57)Abstract:
PURPOSE: To obtain a high frequency switch capable of reducing an insertion loss and simplifying a wiring pattern for supplying control voltage.
CONSTITUTION: The high frequency switch is provided with 1st to 4th ports P1 to P4, 1st to 4th diodes D1 to D4 connected between the 1st and 3rd ports P1, P3, between the 1st and 4th ports P1, P4, between the 2nd and 3rd ports P2, P3, and between the 2nd and 4th ports P2, P4, and distributed constant lines 2a to 2d and capacitors 3a to 3d which are connected between respective ports and reference potential and mutually connected in series. A 1st control voltage terminal V1 is connected between nodes B, E formed between the lines 2a, 2b and capacitors 3a, 3b and a 2nd control voltage terminal V2 is connected between nodes G, I formed between the lines 2c, 2d and capacitors 3c, 3d.



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CLAIMS

[Claim(s)]
[Claim 1] It is the RF switch which realizes the state where have the 1st - the 4th port and the 1st and the 2nd port were connected to the 3rd or 4th port. The 1st, the 2nd, the 3rd, and 4th diodes connected, respectively between the 1st and 3rd port, between the 1st and 4th port, between the 2nd and 3rd port, and between the 2nd and 4th port, It has the distributed constant track and capacitor which are connected between each 4th port and the reference potential, respectively, and were connected in series. aforementioned the 1- the above 1st - the 4th diode The node between the distributed constant tracks and capacitors which the 1st - the 4th diode are connected to the same direction in the ring-like circuit portion connected and constituted, and were connected to the 1st port of the above, The 1st control-voltage terminal connected between the nodes between the distributed constant tracks and capacitors which were connected to the 2nd port of the above, The RF switch characterized by having further the 2nd control-voltage terminal connected between the node between the distributed constant tracks and capacitors which were connected to the 3rd port of the above, and the node between the distributed constant tracks and capacitors which were connected to the 4th port of the above.
[Claim 2] The RF switch according to claim 1 on which the node between the distributed constant tracks and capacitors which were connected to the 1st port of the above, and the node between the distributed constant tracks and capacitors which were connected to the 2nd port of the above are connected to the 1st control-voltage terminal through the 1st and the 2nd resistance, respectively.
[Claim 3] The RF switch according to claim 1 or 2 on which the node between the distributed constant tracks and capacitors which were connected to the 3rd port of the above, and the node between the distributed constant tracks and capacitors which were connected to the 4th port of the above are connected to the 2nd control-voltage terminal through the 3rd and the 4th resistance, respectively.
[Claim 4] The RF switch according to claim 1 to 3 further equipped with the capacitor connected between the node between the above 1st and the 2nd resistance, and the reference potential.
[Claim 5] The RF switch according to claim 1 to 4 further equipped with the capacitor connected between the node between the above 3rd and the 4th resistance, and the reference potential.
[Claim 6] A RF switch given in any of claims 1-5 which are characterized by having further the distributed constant track which is connected in parallel with at least one aforementioned diode, and was connected in series mutually, and a capacitor they are.
[Claim 7] A RF switch given in any of claims 1-5 which are characterized by having further the capacitor connected between the ends of at least one aforementioned diode, and the aforementioned reference potential they are.
[Claim 8] A RF switch given in any of claims 1-5 which are characterized by having further the resistance connected in parallel with at least one aforementioned diode they are.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the RF switch which has four ports and used diode especially about the RF switch for switching a signal path in RF circuits, such as for example, a cellular-phone machine.
[0002]
[Description of the Prior Art] In a cellular-phone machine, two antennas or one antenna, and one external terminal may be shared by the transmitting section and the receive section. With such composition, the switching circuit shown, for example in drawing 6 is used conventionally.
[0003] A switching circuit 151 has the composition which connected the switch 152,153 of three ports. A switch 152 has the 1st port P21, the 2nd port P22, and the 3rd port P23. Similarly, a switch 153 has the 1st - the 3rd port P31, P32, and P33. Antenna ANT is connected to the 2nd port P22 of a switch 152, and let the 3rd port P23 in it be the external end-connection child EXT. In addition, in the 3rd port P23, it is **. The antenna of 2 may be connected. That is, in the cellular-phone machine for mount etc., it is also possible to use it, connecting the antenna with which vehicles were equipped as the 2nd antenna. Moreover, in case the electrical property of the receive section of the cellular-phone machine with which the switching circuit 151 was built in is measured as an example used as an external terminal, the case where a predetermined signal is inputted from an external terminal etc. is mentioned.
[0004] In the switch 152, the 1st port P21 is constituted so that it may be switched to the 2nd port P22 of the above, or the 3rd port P23. The 1st port P21 is connected to the 1st port P31 of a switch 153.
[0005] The 1st port P31 of a switch 153 is constituted so that connection may be switched between the 2nd port P32 and the 3rd port P33. The 2nd port P32 is connected to the transmitting section Tx, and the 3rd port P33 is connected to a receive section Rx.
[0006] By using the above-mentioned switching circuit 151, the state where it connected to the transmitting section Tx or the receive section Rx any of Antenna ANT and the external terminal EXT they were is realizable.
[0007] By the way, as parts for constituting the three above-mentioned port type switch 152,153, the RF switch using the diode shown in drawing 7 is known. The RF switch 161 has the above 1st - the 3rd port P21-P23, and the 1st equivalent to P31-P33 - the 3rd port P61-P63. The port P61 is connected to the cathode of diode 165a through the capacitor 164. The anode of diode 165a is connected to the 2nd port P62 through capacitor 166a. Moreover, the end of distributed constant track 167a is electrically connected to the node A between the anode of diode 165a, and capacitor 166a. Distributed constant track 167a consists of a stripline which has lambda/4 or less length, a microstrip line, a KOPURENA guideline, etc., when wavelength of the RF signal which flows on this switch 161 is set to lambda. The other end of distributed constant track 167a is connected to grounding potential through capacitor 168a. Moreover, the end of resistance 169a is connected to the node between distributed constant track 167a and capacitor 168a, and the other end of resistance 169a is connected to the control-voltage terminal Vc1. Moreover, the 1st port P61 is connected to the distributed constant track 171 constituted like

distributed constant track 167a through the capacitor 164. The other end of the distributed constant track 171 is connected to grounding potential.
[0008] Furthermore, the cathode of diode 165b is connected to the 1st port P61 through the capacitor 164. The anode of diode 165b is connected to the 3rd port P63 through capacitor 166b. Moreover, the series circuit which consists of distributed constant track 167b and capacitor 168b is connected to the anode of diode 165b as well as the diode 165a side between grounding potentials. Moreover, the end of resistance 169b is connected to the node between distributed constant track 167b and capacitor 168b, and the other end of resistance 169b is connected to the control-voltage terminal Vc2.
[0009] With the RF switch 161, the state where the port P61 was connected to the control-voltage terminal Vc1 and the 2nd control-voltage terminal Vc2 by impressing a different control voltage in the state linked to the 2nd port P62 or the 3rd port P63 is realizable. For example, when positive regulation voltage is impressed to the control-voltage terminal Vc1 and negative-control voltage is impressed to another side and the control-voltage terminal Vc2, the bias voltage of the forward direction will be impressed to diode 165a, and the bias voltage of an opposite direction will be impressed to diode 165b. That is, in order to restrict the portion into which a direct current of Capacitors 166a, 168a, 164,166b, and 168b flows, the control current given from the control-voltage terminal Vc1 is cut, and it flows into a circuit portion including distributed constant track 167a, diode 165a, and the distributed constant track 171, and let diode 165a be an ON state. On the other hand, the bias voltage of an opposite direction will be impressed to diode 165b at the diode 165b side, and let diode 165b be an OFF state.
[0010] Moreover, about the RF signal supplied from the 2nd port P62, since distributed constant track 167a is constituted as mentioned above, the end of distributed constant track 167a can be made into grounding potential in RF, and the impedance of a series circuit which consists of distributed constant track 167a and capacitor 168a which were seen from Node A by lambda/4 of impedance reversal becomes infinite. Therefore, the RF signal supplied from the 2nd port P62 flows in the 1st port P61.
[0011] On the other hand, when negative-control voltage is impressed to the 1st control-voltage terminal Vc1 and positive regulation voltage is impressed to the 2nd control-voltage terminal Vc2, contrary to the above, the bias voltage of an opposite direction will be impressed to diode 165a, and the bias voltage of the forward direction will be impressed to diode 165b. Therefore, diode 165a is made into an OFF state, and let diode 165b be an ON state. Therefore, a signal will not flow between the 2nd port P62 and the 1st port P61, but a signal will flow between the 1st port P61 and the 3rd port P63. Also in this case, since the impedance of a series circuit which consists of distributed constant track 167b and capacitor 168b which were seen from Node B becomes infinite, a RF signal does not flow to the distributed constant track 167b side.
[0012] The distributed constant tracks 167a and 167b raise the impedance by the side of distributed constant track 167a seen from Nodes A and B, and 167b to a RF signal, and achieve the function to reduce an insertion loss and a reflection loss while they constitute the current path for passing the control current to Diodes 165a and 165b.
[0013] As mentioned above, with the RF switch 161, the state where the 1st port P61 was switched to the 2nd port P62 or the 3rd port P63 is realizable by impressing positive and negative-control voltage to the control-voltage terminals Vc1 and Vc2.
[0014] Moreover, the switching circuit 151 shown in drawing 6 is constituted by using the above-mentioned RF switch 161 as a switch 152,153. That is, two 3 port RF switches were used and it was constituted by connecting the 1st mutual port mutually.
[0015]
[Problem(s) to be Solved by the Invention] Since the switching circuit 151 was constituted by connecting two RF switches 152,153 as mentioned above, a RF signal will pass two switches. For example, by the time the transmitting output given from the transmitting section Tx is given to Antenna ANT, it will pass two switches 153,152. Similarly, the RF signal inputted from Antenna ANT passes a switch 152,153, and is given to a receive section Rx. Therefore, an insertion loss did not obtain an oak colander greatly, but the reduction was called for strongly. Moreover, since an insertion loss could not but become large, on the occasion of transmission, the transmitting

output needed to be increased and there was a problem of causing the fall of gain on the occasion of reception.
[0016] Moreover, in the above-mentioned switching circuit 151, since the switch 152,153 was constituted using the RF switch 161, in each switch 152,153, the control voltage had to be impressed to the 1st and 2nd control-voltage terminal, therefore two power supplies for control-voltage supply were needed in each switch 152,153. Consequently, the complicated circuit pattern for power supplies had to be formed on the circuit board.
[0017] The purpose of this invention has a small insertion loss, and it is to offer the RF switch which can reduce component part mark and can attain simplification of the circuit pattern for control-voltage supply.
[0018]
[Means for Solving the Problem] this invention is 4 port RF switch which has the 1st - the 4th port, and the state where the 1st and the 2nd port were connected to the 3rd or 4th port is realized.
[0019] With the RF switch of this invention, the 1st - the 4th diode are connected, respectively between the 1st and 3rd port, between the 1st and 4th port, between the 2nd and 3rd port, and between the 2nd and 4th port. above-mentioned the 1- between each 4th port and the reference potential, the distributed constant track and capacitor which were connected in series are connected
[0020] Moreover, since the above 1st - the 4th diode are connected between each port as mentioned above, the ring-like circuit portion to which the 1st - the 4th diode were connected is constituted, and the 1st - the 4th diode are connected to the same direction in this ring-like circuit portion.
[0021] Furthermore, the 1st control-voltage terminal is connected to the node between the distributed constant tracks and capacitors which were connected to the 1st port of the above, and the node between the distributed constant tracks and capacitors which were connected to the 2nd port. Similarly, the 2nd control-voltage terminal is connected between the node between the distributed constant tracks and capacitors which were connected to the 3rd port, and the node between the distributed constant tracks and capacitors which were connected to the 4th port.
[0022] Moreover, on a specific aspect of affairs with the RF switch of this invention, the node between the distributed constant tracks and capacitors which were connected to the 1st port of the above, and the node between the distributed constant tracks and capacitors which were connected to the 2nd port are connected to the 1st control-voltage terminal through the 1st and the 2nd resistance, respectively.
[0023] Moreover, on other specific aspects of affairs of this invention, the node and the node between the distributed constant tracks and capacitors which were connected in the 4th port are connected to the 2nd control-voltage terminal through the 3rd and the 4th resistance, respectively between the distributed constant tracks and capacitors which were connected to the 3rd port of the above.
[0024] According to the desirable aspect of affairs of this invention, a capacitor is connected between the node between the above 1st and the 2nd resistance, and a reference potential. Moreover, in another desirable example of this invention, the capacitor is connected between the node between the above 3rd and the 4th resistance, and the reference potential.
[0025] With the RF switch of this invention, it has further the distributed constant track and capacitor which are connected in parallel with at least one above-mentioned diode, and were connected in series preferably.
[0026] Moreover, in other desirable examples of this invention, a capacitor is connected between the ends of at least one above-mentioned diode, and a reference potential. According to other still more desirable aspects of affairs of this invention, resistance is connected in parallel with at least one above-mentioned diode.
[0027]
[Function and Effect of the Invention] With the RF switch of this invention, between the 1st and 3rd port, between the 1st and 4th port, between the 2nd and 3rd port, and between the 2nd and

4th port are connected by diode, respectively. Moreover, the above 1st – the 4th diode constitute the circuit portion of the shape of a ring connected as mentioned above, and are connected to the same direction along with the hoop direction in this ring-like circuit portion. Moreover, since the above 1st – the 4th port are connected as mentioned above, along with the hoop direction of a ring-like circuit portion, each port will be connected in order of the 1st port, the 3rd port, the 2nd port, and the 4th port.
[0028] therefore, for the 4th diode connected between the 1st diode connected between the 1st and 3rd port and the 2nd, and 4th port The 1st control-voltage terminal is connected to a cathode or an anode, and the 2nd control-voltage terminal is connected to an anode or a cathode. for another side, the 2nd, and the 3rd diode The 2nd control-voltage terminal will be connected to an anode or a cathode, and the 1st control-voltage terminal will be connected to a cathode or an anode. That is, the 1st, the 4th diode, and the 2nd and the 3rd diode are connected to the retrose to the 1st and 2nd control-voltage terminal, although it connects with the same direction in the hoop direction of a ring-like circuit portion. Therefore, by impressing the 1st and the 2nd control voltage to the 1st and 2nd control-voltage terminal so that the above 1st, the 4th diode or the 2nd, and the 3rd diode can be made into an ON state The state where the 1st and the 4th diode were made into the ON state, and between the 1st and 3rd port and between the 2nd and 4th port were connected (1st connection state), Or the 2nd and the 3rd diode are made into an ON state, and the state (2nd connection state) where between the 1st and 4th port and between the 2nd and 3rd port were connected can be realized.
[0029] In addition, the series circuit which becomes a node between each port and diode from the above-mentioned distributed constant track and a capacitor is connected between reference potentials. Therefore, the impedance at the time of seeing a distributed constant track side from this node to a RF signal becomes infinite. therefore, where the RF signal did not flow to a reference potential side but between the above 1st and the 3rd port and between the 2nd and 4th port are connected Between the 1st and 3rd port and between the 2nd and 4th port can be flowed, and it may flow between the 1st and 4th port and between the 2nd and 3rd ports in the state where between the 1st and 4th port and between the 2nd and 3rd port were connected.
[0030] As mentioned above, with the RF switch of this invention, the RF signal which flows between the ports of a couple will flow only one diode connected between the ports of a couple. On the other hand, when a switching circuit 151 was constituted using the conventional 3 port type RF switch 152,153, the RF signal had passed two diodes. Therefore, according to this invention, the life of the element which can reduce an insertion loss by half compared with the conventional switching circuit 151, and constitutes a RF switch can also be lengthened. Therefore, when used, for example for a cellular-phone machine, exhaustion of a cell is pressed down and it becomes possible to lengthen duration of a call and waiting time.
[0031] And 4 port type RF switching circuit can be constituted only from a RF switch of this invention, and a control voltage requires the above 1st and only the 2nd control voltage. Therefore, compared with the case where the switching circuit of four ports is constituted using the conventional RF switch 152,153, the number of control terminals can be reduced by half, and a control-voltage supply circuit pattern can be simplified. In addition, since what is necessary is just to only supply one kind of control voltage, for example, positive or negative supply voltage, to one control-voltage terminal in that case since it is also possible to make one side of the 1st and the 2nd control voltage into grounding potential, the circuit pattern in the printed-circuit board with which a RF switch is mounted can be simplified further. Therefore, it can contribute to the miniaturization of the electronic equipment by which a RF switch is incorporated greatly.
[0032] Furthermore, with the RF switch of this invention, the 1st and the 2nd port can use suitable for the change-over switch for diversity antennas etc. symmetrically therefore about the connection to the 3rd and the 4th port.
[0033] Moreover, with the composition which connected to the 1st control-voltage terminal the node between the distributed constant tracks and capacitors which were connected to the node between the distributed constant tracks and capacitors which were connected to the 1st port through the above 1st and the 2nd resistance, and the 2nd port, the resistance of the 1st and the 2nd resistance can adjust the value of the control current easily.

[0034] Also in the composition which similarly connected to the 2nd control-voltage terminal each node between the distributed constant tracks and capacitors which were connected to the 3rd and the 4th port through the 3rd and the 4th resistance, the value of the 2nd control current impressed to a RF switch with the resistance of the 3rd and the 4th resistance can be adjusted.
[0035] Furthermore, with the composition which connected the capacitor, this capacitor can raise the isolation between the 1st and 2nd port and between the 3rd and 4th port between the node during the composition which connected the capacitor between the node during the 1st and 2nd resistance, and the reference potential and the 3rd, and 4th resistance, and a reference potential.
[0036] Moreover, a parallel resonant circuit is constituted from composition which connected in parallel the distributed constant track mutually connected to at least one diode in series, and the capacitor by the electrostatic capacity of the OFF state of diode, and the impedance of a distributed constant track. Therefore, by constituting so that the resonance frequency of this parallel resonant circuit may be made in agreement with the frequency of the RF signal which flows on a switch, the impedance of the OFF state of diode can be raised and it can raise an isolation property. In addition, it functions as a capacitor preventing the bypass of a direct current to a circuit portion including the distributed constant track connected in parallel with the above-mentioned diode in this case.
[0037] Moreover, when a capacitor is connected between the ends of at least one diode, and the above-mentioned reference potential, this capacitor can adjust a characteristic impedance and reduction of an insertion loss or a reflection loss can be aimed at by it. Moreover, the length of the distributed constant track of the above 1st can be shortened, and it can contribute to the miniaturization of a RF switch.
[0038] Furthermore, with the composition which connected the 2nd resistance in parallel with at least one diode, while the charge accumulated at the electrostatic capacity when being in the OFF state of diode will be in an ON state, it discharges to this resistance. Therefore, the switching operation from the OFF state of diode to an ON state can be carried out smoothly. Moreover, the reverse bias of the diode at the time of OFF can also be stabilized.
[0039]
[Example] Hereafter, this invention is clarified by explaining an example, referring to a drawing.
[0040] Drawing 1 is a schematic-drawing-circuit diagram for explaining the RF switch of one example of this invention. the RF switch 1 of this example -- the 1- the 4th port P1 -P4 It is 4 port RF switch which it has. in order to switch between the 1st and 3rd port -- the 1st diode D1 — between the 1st and 4th port, diode D3 is connected between the 2nd and 3rd port, and diode D4 is connected for diode D2 between the 2nd and 4th port That is, the 1st - the 4th diode D1-D4 will be connected in the shape of a ring.
[0041] And with the RF switch 1 of this invention, the following connection state [1st] and the 2nd connection state are realized, and it is supposed that switching among these connection states is possible. In the 1st connection state, it is the 1st, the 3rd port P1, and P3. Between and the 2nd and the 4th port P2, and P4 Between is connected. Moreover, in the 2nd connection state, it is the 1st, the 4th port P1, and P4. Between and the 2nd and the 3rd port P2, and P3 The state where between was connected is realized.
[0042] Therefore, the RF switch of this invention can be suitably used for the switching circuit 151 of drawing 6 . namely, in the RF switching circuit 151 of drawing 6 The state (at the time of transmission) where the transmitting section Tx was connected to Antenna ANT, the state where the transmitting section Tx was connected to the external terminal EXT (when connecting the 2nd antenna to the external terminal EXT and transmitting to it etc.), The state (at the time of reception) where Antenna ANT was connected to the receive section Rx, or the state where the external terminal EXT was connected to the receive section Rx should just be realized (when connecting to the external end-connection child EXT the case where the performance of a receive section is evaluated, and an external antenna and receiving etc.). When the RF switch 1 of this example is used, it is the 1st port P1 of the above. To the transmitting section Tx, it is the 2nd port P2. It connects with a receive section Rx and is the 3rd port P3. And 4th port P4 It can use like the RF switching circuit 151 by connecting with Antenna ANT and the external

terminal EXT, respectively. But with the RF switch 1, as mentioned above, although between the 1st and 3rd port and between the 2nd and 4th port are connected in the state of the 1st connection, at the time of transmission or reception, either the transmitting section Tx and the receive section Rx are used. Therefore, since what is necessary is to use between the ports of a couple as mentioned above though between two pairs of ports was connected in the 1st and 2nd connection state, respectively, the RF switch 1 can be used instead of the RF switching circuit 151.

[0043] Drawing 2 is the circuit diagram of the RF switch 1 of this example. At this example, it is the 1st, the 3rd port P1, and P3. In between the 1st diode D1 The 1st, the 4th port P1, and P4 The 2nd diode D2 is the 2nd, the 3rd port P2, and P3 in between. The 3rd diode D3 is the 2nd, the 4th port P2, and P4 in between. The 4th diode D4 is connected in between. That is, it connects in the shape of a ring like illustration, and the 1st - the 4th diode D1-D4 are connected to the same direction in the hoop direction of this ring-like circuit portion.

[0044] The 1st port P1 It connects with the cathode of the anode of the 1st diode D1, and the 2nd diode D2. The 1st port P1 The series circuit which consists of distributed constant track 2a and capacitor 3a between the node A between diodes D1 and D2 and grounding potential is connected. Distributed constant track 2a consists of a stripline of lambda/4 or less length, a microstrip line, a KOPURENA guideline, etc., when wavelength of the RF signal which flows on the RF switch 1 is set to lambda.

[0045] Although it is lambda/4 so-called track, since it has the influence of a part for the inductance of a stripline, or stray capacity, the above-mentioned distributed constant track 2a is constituted in fact so that it may have lambda/4 or less length as mentioned above.

[0046] The end of resistance 4a is connected to the node B between distributed constant track 2a and capacitor 3a. The other end of resistance 4a is the 1st control-voltage terminal V1. It connects. Similarly, it is the 2nd port P2. It connects with the anode of the cathode of the 3rd diode D3, and the 4th diode D4, and is these diodes D3 and D4 and 2nd port P2. Distributed constant track 2b and capacitor 3b are connected between the node D of a between, and grounding potential. Distributed constant track 2b and capacitor 3b are constituted like distributed constant track 2a and capacitor 3a. The end of resistance 4b is connected to the node E between distributed constant track 2b and capacitor 3b, and the other end of resistance 4b is the 1st control-voltage terminal V1. It connects. Namely, Resistance 4a and 4b minds Node C, and is the 1st control-voltage terminal V1. It connects.

[0047] Resistance 4a and 4b is the 1st control-voltage terminal V1. It is prepared in order to adjust the value of the 1st control voltage given to a RF switch through the shell nodes B and E. Therefore, depending on the case, for Resistance 4a and 4b, it does not connect, but ** is also good and Nodes B and E are the 1st control-voltage terminal V1 directly in that case. It connects.

[0048] The 3rd port P3 It connects with the anode of the cathode of the 1st diode D1, and the 3rd diode D3. These diodes D1 and D3 and 3rd port P3 Between the node F of a between, and grounding potential, distributed constant track 2c and capacitor 3c are connected. Distributed constant track 2c and capacitor 3c are constituted like above-mentioned distributed constant track 2a and capacitor 3a.

[0049] Moreover, the end of resistance 4c is connected to the node G between distributed constant track 2c and capacitor 3c. The other end of resistance 4c is the 2nd control-voltage terminal V2. It connects.

[0050] Similarly, it is the 4th port P4. It connects with the cathode of the anode of the 2nd diode D2, and the 4th diode D4. The 4th port P4 Between the node H between such diodes D2 and D4, and grounding potential, 2d [of distributed constant tracks] and capacitor 3d is connected. It is constituted like distributed constant track 2a and capacitor 3a 2d [of distributed constant tracks], and capacitor 3d. Moreover, the other end which the end of 4d of resistance is connected to the node I between 2d [of distributed constant tracks] and capacitor 3d, and is 4d of resistance is the 2nd control-voltage terminal V2. It connects. Namely, Resistance 4c and 4d minds Node G, and is the 2nd control-voltage terminal V2. It connects.

[0051] Next, operation of the RF switch 1 is explained. First, when realizing the connection state

of the above 1st, it is the 1st control-voltage terminal V1. Positive supply voltage +Vcc is impressed and it is the 2nd control-voltage terminal V2. It grounds. in this case, 1st control-voltage terminal V1 from -- the voltage drop of the given control voltage is carried out by resistance 4a, and it is impressed to the 1st diode D1 as bias voltage of the forward direction Similarly, the control voltage which deducted a part for the voltage drop by 4d of resistance is impressed also to diode D4 as bias voltage of the forward direction. Therefore, let diodes D1 and D4 be ON states. In addition, Capacitors 3a, 3b, 3c, and 3d achieve the function which omits a direct current.

[0052] On the other hand, Node F minds distributed constant track 2c and resistance 4c, and is the 2nd control-voltage terminal V2. Since it connects, the bias voltage of an opposite direction is impressed to the 3rd diode D3. It is similarly impressed in the bias voltage of an opposite direction about the 2nd diode D2. Therefore, let diodes D2 and D3 be OFF states.

[0053] Therefore, the 1st, the 3rd port P1, and P3 A RF signal may flow between the 2nd, the 4th port P2, and P4 in between. In this case, in Nodes A, D, F, and H, the above-mentioned distributed constant tracks 2a-2d and Capacitors 3a-3d are connected between reference potentials, and when a distributed constant track side is seen from these nodes A, D, F, and H, the impedance is made infinite, respectively. Therefore, a RF signal does not flow from Nodes A, D, F, and H to a distributed constant track side.

[0054] Contrary to the above, in realizing the 2nd connection state, it impresses positive supply voltage +Vcc to the 2nd control-voltage terminal V2, and it is the 1st control-voltage terminal V1. What is necessary is just to ground. In this case, the 2nd diode D2 and 3rd diode D3 are made into an ON state, and it is the 1st, the 4th port P1, and P4. Between and the 2nd and the 3rd port P2, and P3 Between is connected. On the other hand, the 1st diode D1 and 4th diode D4 are made into an OFF state, and it is the 1st, the 3rd port P1, and P3. Between and the 2nd and the 4th port P2, and P4 In between, a signal does not flow.

[0055] as mentioned above, the 1st connection state and the 2nd connection state which were mentioned above according to the RF switch 1 of this example -- the 1st and 2nd control-voltage terminal V1 and V2 from -- it is realizable by impressing a control voltage as mentioned above In this case, by the RF switch 1, it is the 1st and 2nd control-voltage terminal V1 and V2. Since what is necessary is just to impress a control voltage, compared with the case where the RF switching circuit 151 is constituted using the RF switch 161 shown in drawing 7 , the circuit pattern for control-voltage supply can be simplified.

[0056] And it is the 1st and 2nd control-voltage terminal V1 and V2 as mentioned above. Since one side can be made into grounding potential among the control voltages applied, a required control voltage is good at one kind. Therefore, it is also possible to simplify the circuit pattern for control-voltage supply, and the printed-circuit board with which the RF switch 1 is mounted by it can be miniaturized.

[0057] In addition, it replaces with positive supply voltage +Vcc, and is negative supply voltage. - You may use Vcc. In this case, it sets in the connection state of the above 1st, and is the 1st control-voltage terminal V1. It grounds and is the 2nd control-voltage terminal V2. Negative supply voltage - What is necessary is just to impress a control voltage to realizing the 2nd connection state contrary to this that what is necessary is just to impress Vcc.

[0058] Moreover, although diodes D1-D4 were connected to the sense shown in drawing 2 in the above-mentioned example, you may connect with the sense and reverse which are shown in drawing 2 . That is, further, the cathode of diode D3 may connect diodes D1-D4 to Node F side so that the cathode of diode D4 may become Node D side so that the anode of diode D2 may become [the cathode of diode D1] Node A Node A side. In this case, what is necessary is just to choose the control voltage impressed to the above 1st and the 2nd control-voltage terminal according to it with the example shown in drawing 2 , since the polarity of diode becomes reverse.

[0059] Moreover, with the RF switch 1 of this example, only one diode exists between the ports of the couple connected in the above 1st and the 2nd connection state. That is, in the 1st connection state, when passing a RF signal between the 1st and 3rd port, this RF signal will flow only diode D1. Therefore, a RF signal can reduce an insertion loss by half compared with the

conventional RF switching circuit 151 which did not obtain a flow colander for two diodes.
[0060] Moreover, the 1st, the 2nd port P1, and P2 The 3rd port P3 And 4th port P4 It is symmetrical about the receiving connection. Therefore, the RF switch 1 of this example can be used suitable for the change-over switch for diversity antennas etc.
[0061] Next, it explains per desirable modification of the RF switch 1. a dashed line shows to drawing 2 -- as -- desirable -- the 1- the 4th port P1 -P4 respectively -- between reference potentials -- capacitor C1 -C4 You may connect. capacitor C1 -C4 [in this case,] choosing electrostatic capacity -- a characteristic impedance -- an amendment -- things are made and the insertion loss and reflection loss of the RF switch 1 can be effectively reduced by it In addition, distributed constant tracks [2a-2d] length can also be shortened, and the miniaturization of the RF switch 1 can be achieved by it.
[0062] In addition, at drawing 2 , it is a capacitor with a dashed line C1 -C4 Although shown, it is these capacitor C1 -C4. There is not necessarily no need that all are used, and only either may be connected.
[0063] Moreover, preferably, as a dashed line shows to drawing 2 , it is a capacitor C5 and C6 between Nodes C and J and a reference potential. You may connect and it can raise the isolation between the 1st and 2nd port and between the 3rd and 4th port.
[0064] Next, other desirable modifications which can be applied to the RF switch of the above-mentioned example are further explained with reference to drawing 3 - drawing 5. Each below-mentioned circuit element is connected to the arbitrary diodes of the diodes D1-D4 in the modification shown in drawing 3 - drawing 5 . Suppose that it explains per [which is prepared in diode D1] portion on behalf of diodes D1-D4 in drawing 3 - drawing 5 .
[0065] As shown in drawing 3 , in the 1st modification, the electric discharge resistance 92 is connected in parallel with diode D1. Diode D1 functions as a capacitor in direct current, when it is in an OFF state. Therefore, the distributed constant track 93 connected to diode D1 in parallel, mutually, and in series in the modification in which a stored charge discharges to the electric discharge resistance 92 with the composition shown in drawing 3 although it will flow while diode D1 is turned on by the charge accumulated when it was in an OFF state, therefore the switching operation from the OFF state of diode D1 to an ON state is carried out smoothly, and which is shown in drawing 4 again, and a capacitor 94 are connected. The amount of [the electrostatic capacity in the OFF state of diode D1 and / of the distributed constant track 93] inductance consists of [a parallel resonant circuit] this composition. Therefore, the resonance frequency of this parallel resonant circuit can raise the impedance of the OFF state of diode D1 by adjusting a part for the inductance of the above-mentioned distributed constant track 93 so that it may be in agreement with the frequency of the RF signal transmitted. Consequently, the isolation property between the next ports which sandwiched the diode D1 when being in an OFF state can be raised. In addition, the capacitor 94 is formed in order to prevent that a direct current bypasses on the distributed constant track 93.
[0066] Moreover, as mentioned above, although the above-mentioned distributed constant track 93 may be constituted by a stripline, a microstrip line, the KOPURENA guideline, etc., the length and impedance are chosen so that the resonance frequency of a parallel resonant circuit may be made in agreement with the frequency of a RF signal.
[0067] The distributed constant track 93 for constituting a parallel resonant circuit from a modification shown in drawing 5 in parallel with diode D1 is connected. Moreover, the capacitor 94 is connected to the distributed constant track 93 in series. Furthermore, the capacitor 95 is connected in parallel with diode D1 in parallel with the circuit portion which consists of a distributed constant track 93 and a capacitor 94. Thus, in the composition shown in drawing 4 , when the electrostatic capacity of the OFF state of diode D1 is small, a part for the compound electrostatic capacity of the electrostatic capacity of the OFF state of diode D1 and the electrostatic capacity of a capacitor 94 and the inductance of the distributed constant track 93 can constitute a parallel resonant circuit, and the resonance frequency of a parallel resonant circuit can be easily made in agreement with the frequency of a RF signal by adding a capacitor 95 by it.

[Translation done.]

* NOTICES *

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The schematic-drawing-circuit diagram showing the outline composition of the RF switch of one example of this invention.
[Drawing 2] The circuit diagram of the RF switch of one example of this invention.
[Drawing 3] The circuit diagram for explaining a modification with a desirable RF switch.
[Drawing 4] The circuit diagram for explaining other examples of a modification with a desirable RF switch.
[Drawing 5] The circuit diagram for explaining the modification of further others with a desirable RF switch.
[Drawing 6] The schematic-drawing-block diagram for explaining the conventional RF switching circuit.
[Drawing 7] The circuit diagram showing an example of the conventional 3 port type RF switch.
[Description of Notations]
1 -- RF switch
2a, 2b, 2c, 2d -- Distributed constant track
3a-3d -- Capacitor
D1-D4 -- The 1st - the 4th diode
P1 -P4 -- The 1st - the 4th port
A-J -- Node
4a, 4b -- The 1st, 2nd resistance
4c, 4d -- The 3rd, 4th resistance
C1 -C6 -- Capacitor
92 -- Electric discharge resistance
93 -- Distributed constant track
94 95 -- Capacitor

[Translation done.]

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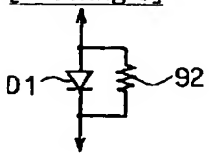
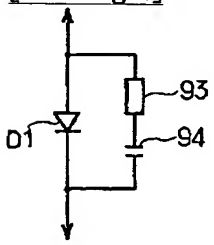
DRAWINGS

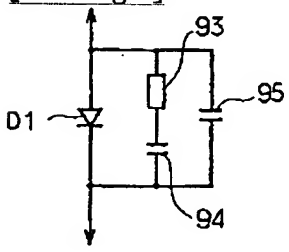
[Drawing 3]



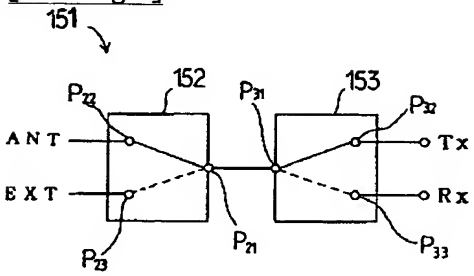
[Drawing 4]



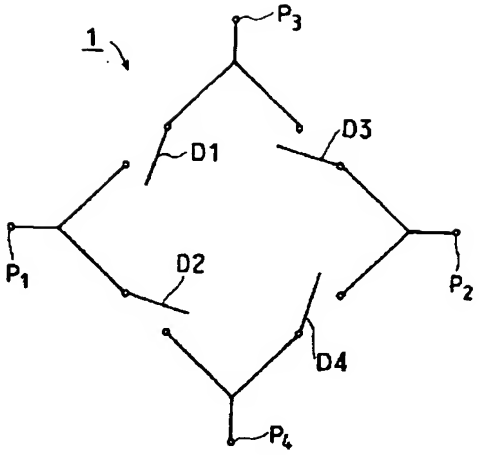
[Drawing 5]



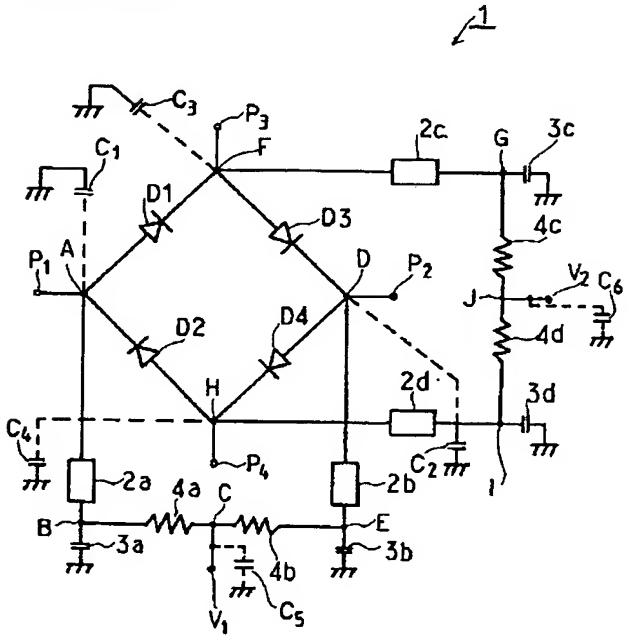
[Drawing 6]



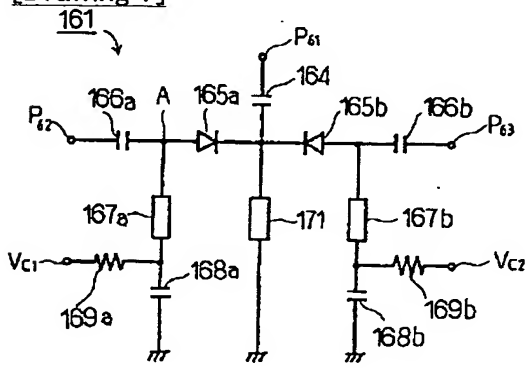
[Drawing 1]



[Drawing 2]



[Drawing 7]



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